

Atlantic Ocean Occurrences of the Sea Lamprey,
Petromyzon marinus (Petromyzontiformes:
Petromyzontidae), Parasitizing Sandbar, *Carcharhinus*
plumbeus, and Dusky, *C. obscurus* (Carcharhiniformes:
Carcharhinidae), Sharks off North and South Carolina

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ABSTRACT—Sandbar and dusky sharks captured in 1993 in western Atlantic Ocean waters off North and South Carolina were parasitized by sea lampreys. All lampreys were females ranging from 165 to 343 mm total length. Removal of an attached lamprey revealed round, reddish and/or bleeding areas on a shark's body. Blood oozing from a lamprey's cloaca indicated that feeding was occurring or had occurred.

The anadromous parasitic sea lamprey (*Petromyzon marinus*) is widely distributed on both sides of the Atlantic Ocean. It occurs off North America from Labrador southward to Florida, and along eastern Europe from Varanger Fjord in Norway to the western Mediterranean (Beamish 1980). Apparently it also formerly occurred in the Gulf of Mexico (Vladykov and Kott 1980, Gilbert and Snelson 1992). Lampreys are known from marine waters to depths of 4,099 m (Haedrich 1977). Dempson and Porter (1993) note other western Atlantic captures of sea lampreys in deep open ocean waters. Excellent reviews of sea lamprey biology can be found in Hardesty and Potter (1971) and in the Proceedings of the Sea Lamprey International Symposium (1980). We add the sea lamprey as an external parasite of sharks and present meristic and morphometric data for specimens captured off North and South Carolina.

Sea lampreys prey on a variety of fishes in freshwater and marine habitats (Bigelow and Schroeder 1948). Sea lampreys have not been reported from ocean habitats off North Carolina (personal observation) or South Carolina (S. Van Sant, South Carolina Marine Resources Center, personal communication), although lamprey captures are known from inland North Carolina streams and Albemarle Sound (Smith 1907, Menhinick 1991). Schwartz et al. (1982) reported a 140-mm total length (TL), 3.9-g specimen (UNC 8501) entangled in a gill net on the west side (Station 19 west) of the Cape Fear River, 4 km north of Southport, North Carolina, from waters of 10.2C and 10 ppt salinity on 19 February 1974. Whether it was attached to a fish caught in the net was unknown.

PREVIOUS SEA LAMPREY—SHARK PARASITISM RECORDS

We know of two verified records of sea lamprey—shark parasitism. One involves a female sea lamprey and a basking shark (*Cetorhinus maximus*), specimen 965-2-3-1, of the Nova Scotia Museum (Bigelow and Schroeder 1948). The lamprey was 290-mm TL when preserved in formalin. The 7.6-m-long basking shark, caught 29 June 1965 in a gill net off Hopson Island (near Prospect), Halifax County, Canada, was alive when the lamprey was removed. Attachment was just above and anterior to the base of the anal fin, although sea lampreys often attach to pectoral fins and along the dorsal and body sides (Cochran 1985, 1986). The second was a record of two adult lampreys, 180- and 250-mm TL (USNM 130791) taken from an unknown species of shark captured 3 June 1885 off Cape Charles, Virginia, at Albatross Station 2422 at 37°08'30"N, 74°33'30"W (Jenkins and Burkhead 1993).

RECENT SEA LAMPREY—SHARK PARASITISM RECORDS

South Carolina—We captured a female sea lamprey (UNC 17398), 168-mm TL, 8.8 g, on 6 February 1993 while longlining 69 km off South Carolina in 31.1 m of water. Set location began at 33°10.9'N, 78°17.45'W and ended at 33°00'N, 78°24.08'W. It was still attached to a 1280-mm fork length (FL), male sandbar shark (*Carcharhinus plumbeus*) along the shark's right lateral flank midway between the rear tips of the pelvic and dorsal fins on the gray portion of the skin. Removal of the lamprey revealed a round reddish area on the side of the body, which indicates that it had been attached for some time before the shark's capture. Blood oozed freely from the female lamprey's cloacal opening.

North Carolina—We know of five recent occurrences (March 1993) of female sea lampreys parasitizing sharks captured from two different locations off North Carolina; the host in one case was a 3-m-FL dusky shark (*Carcharhinus obscurus*), the others three 3-m-FL sandbar sharks (*C. plumbeus*). A dusky shark and one sandbar shark, captured by fishermen longlining 74-km east-southeast off Masonboro, North Carolina, carried one feeding lamprey attached near the cloaca of each shark. But the lampreys were not retained by the fishermen who captured the sharks.

Three additional female sea lampreys (UNC 17403, Table 1) 165-, 178-, and 343-mm TL, weighing 6.4, 9.5, and 70.7 g, respectively, were captured 23 March 1993 during nighttime longlining sets 46.2 km east of Cape Lookout in 31–36-m waters. All three specimens parasitized 3-m-TL female dusky sharks, one was attached to a pelvic fin, the others to the white skin of the cloacal area. No masses were taken of any shark at sea. Body proportions of the North Carolina preserved sea

Table 1. Meristic and morphometric data for sea lampreys captured parasitizing dusky and sandbar sharks caught off South Carolina (UNC 17398) and North Carolina (17403), 1993. Lengths are expressed as a percentage of the total length.

Lengths (% total length)	Female Sea Lampreys			
	UNC 17398 ¹	UNC 17403 ²		
Predorsal	14.9	15.3	15.2	13.1
Branchial	10.8	8.7	8.8	8.7
Disc	9.0	9.3	9.3	8.5
Eye	3.3	3.0	2.2	2.3
Trunk	45.1	46.1	49.7	53.6
Tail	29.1	29.8	26.2	24.5
Myomere	68	66	67	— ³
Total Length (mm)	168	165	178	343

¹Host female sandbar shark.

²Hosts all female dusky sharks.

³Dark adult body coloration prevented accurate myomere count.

lampreys (Table 1) were larger than those reported for a 136-mm-TL specimen from Florida (Vladykov and Kott 1980).

CONCLUSIONS

Sea lamprey-shark parasitism occurrences are rarely reported because fishermen or scientists often think that a reddened bleeding area on the body is simply a bruise rather than a wound caused by a lamprey. Likewise, a lamprey might have fallen off once a shark was landed, making the association of the injury with a lamprey difficult. Information on sea lampreys from sharks caught at sea may shed more information on their occurrence, seasonality, water depth frequented, host preferences, and biology of sea lampreys than is presently known. Lamprey parasitism may be more damaging to marine fishes than now suspected.

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Clutch Parameters of *Storeria dekayi* Holbrook (Serpentes: Colubridae) from Southcentral Florida

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ABSTRACT—I examined clutch characteristics from a series of *Storeria dekayi* collected in southcentral Florida from March to July 1990. Clutch size averaged 8.5 and was not significantly associated with female body size. The small clutch sizes of this sample conformed to predictions of clutch size reduction in southern populations. However, the data did not support predictions of increased clutch number in southern populations. Possibly, high relative clutch mass detected in this population and an unaltered breeding season hinder production of more than one clutch annually.

Two latitudinal clines in snakes have been proposed that predict differences in clutch size and number along a geographic gradient. The first predicts a decrease in clutch size from north to south (Fitch 1985). The second hypothesis predicts an increase in clutch number at lower latitudes concomitant with a longer reproductive season (Fitch 1970).

The reproductive biology of *Storeria dekayi* in Florida is poorly known; however, parturition dates of this species are available from Florida (Iverson 1978), and they do not differ from parturition dates in more northern populations (Fitch 1970). Iverson's (1978) data do not support the prediction of a latitudinal cline in clutch number for this species.

With few exceptions, Iverson (1978) found that most Florida snake species he examined did not conform to the prediction of multiple clutches in southern populations. In this article I present additional reproductive data for female *S. dekayi* from south Florida which permit testing Fitch's (1985) hypothesis of clutch size reduction in southern populations and further evaluation of the likelihood of multiple clutch production in this species at the southern limit of its geographic range (Fitch 1970).

METHODS

Snakes were collected from 1830 to 2200 hours from a paved road (C-621) near Lake Placid, Highlands County, Florida, during March-July 1990. All snakes observed were collected, frozen within 3 hours of capture, and dissected the next day.

Condition of follicles was staged according to Kofron (1979). I estimated clutch size by counting enlarged follicles or conceptuses. Relative clutch mass, the quotient of clutch mass divided by the sum of the clutch mass and the female body mass (Seigel and Fitch 1984), was measured in females with fully developed conceptuses. All specimens are located in the Archbold Biological Station vertebrate collection.

RESULTS AND DISCUSSION

Eighteen snakes (3 males, 15 females) were collected during 22.5 hours of searching. Snout-vent lengths (SVL) of males collected in March ($n = 1$) and June ($n = 2$) were 23.0, 25.0, and 27.5 mm, respectively. Snout-vent lengths and clutch parameters of females are summarized in Table 1. Estimated clutch size was not significantly correlated with SVL ($r = 0.31$, $P > 0.05$).

Table 1. Snout-vent lengths (SVL) and clutch parameters of *Storeria dekayi* collected from one location in Highlands County, Florida, 1990.

Date	Female SVL	Clutch Size	Relative Clutch Mass	Neonate SVL (cm)
17 March	24.6	7		
17 March	21.8	7		
17 May	26.0	12	0.400	6.3 + 0.306
25 May	28.0	spent		
29 May	24.3	8	0.361	
31 May ¹	25.3	9		7.7 + 0.500
8 June	26.0	spent		
8 June	29.0	11		
14 June	28.0	10	0.340	8.4 + 0.097
21 June	27.5	5		
21 June	27.5	10		
24 June	26.5	8		
3 July	33.0	9		
23 July	26.0	5		
24 July	28.5	10		
31 July	25.3	9		
\bar{x}	26.8	8.5	0.367	
SD	2.55	2.15	0.030	
Range	21.8–33.0	5–12	0.340–0.400	
n	15	13	3	

¹ Denotes a specimen collected in 1992 from the same site. Data not analyzed with 1990 sample.

Mean clutch size (8.5) was similar to that found in Everglades National Park by Dalrymple et al. (1992), and the samples from both regions had a female - biased sex ratio. Female *S. dekayi* from Iverson's (1978) northern Florida sample had smaller SVL than females from my study ($t = 3.681$; $df = 10$; $P < 0.004$), but the two samples did not differ significantly in clutch size. Although both mean female SVL (27.3 mm) and clutch size (14.0) from *S. dekayi* near Lake Erie (King 1993) were significantly larger than those of my study ($t = 2.12$ $P = 0.05$; and $t = 7.53$ $P < 0.00$, respectively; $df = 38$), the difference in SVL was marginal. Mean clutch sizes, 14.9 in Louisiana (Kofron 1979) and 14 in New York (Clausen 1936), are also substantially larger than those for Florida, which supports Fitch's (1985) prediction of smaller clutch sizes in southern latitudes.

A review of relative clutch mass in snakes indicates that there is a reduction in relative clutch mass among viviparous forms that may reduce the risk of mortality in gravid females (Seigel and Fitch 1984). The cost of lowering relative clutch mass is a reduction of clutch size, offspring size, or both. Resources could limit production of more than one clutch (Bull and Shine 1979), but a large clutch could compensate for a single brood (Seigel and Fitch 1984). Mean relative clutch mass in *S. dekayi* from southern Florida was high (0.367) and similar to that (0.372) recorded for *S. dekayi* from Maryland (Jones 1976). A high relative clutch mass in southern Florida *S. dekayi* may compensate for a single small clutch produced each season.

In northern Florida, females with fully developed conceptuses were recorded from July to September (Iverson 1978). In southern Florida, the earliest date was May (Iverson 1978, my study), and in Everglades National Park captive females gave birth from June to September (Dalrymple et al. 1992). Collectively, the breeding season of Florida populations of *S. dekayi* (Iverson 1978, Dalrymple et al. 1992, my study) falls within the range of other populations (Fitch 1970, Kofron 1979). Further, my results did not indicate a reduction of relative clutch mass, which could facilitate multiple clutch production, in southern Florida *S. dekayi*.

CONCLUSIONS

Clutch frequency of this species in southern Florida has not been determined to date, and multiple clutch production, even if infrequent, has not been excluded. An annual sample of specimens or mark-recapture will best answer this question. Results of my study do not support Fitch's (1970) prediction of multiple clutch production by *S. dekayi* in the southern part of the range.

However, clutch sizes from south Florida *S. dekayi* were smaller than northern populations as predicted by Fitch (1985) and unaffected by female body size. Possibly, a high relative clutch mass and an unaltered breeding season limit this population to one brood annually.

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